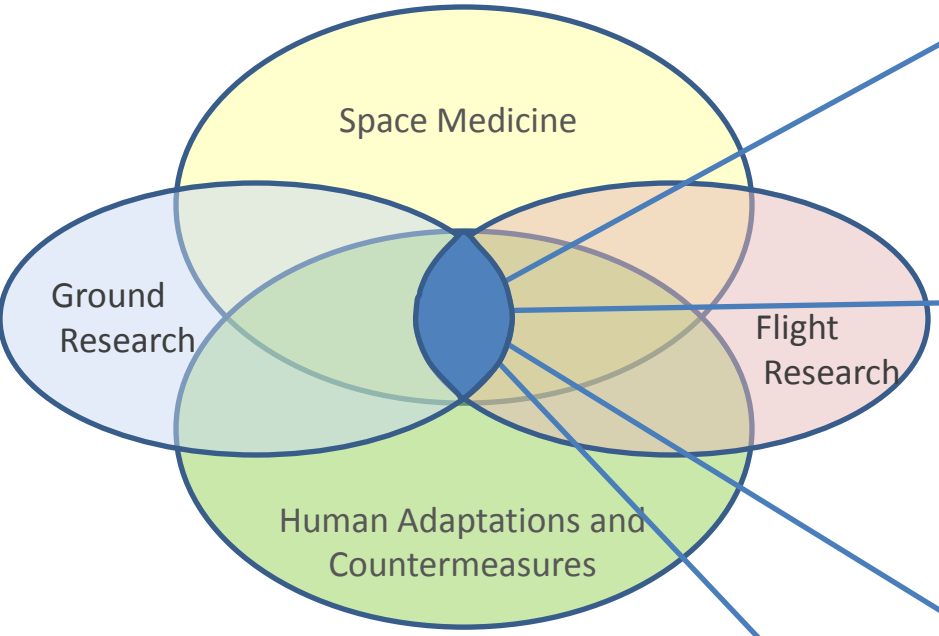
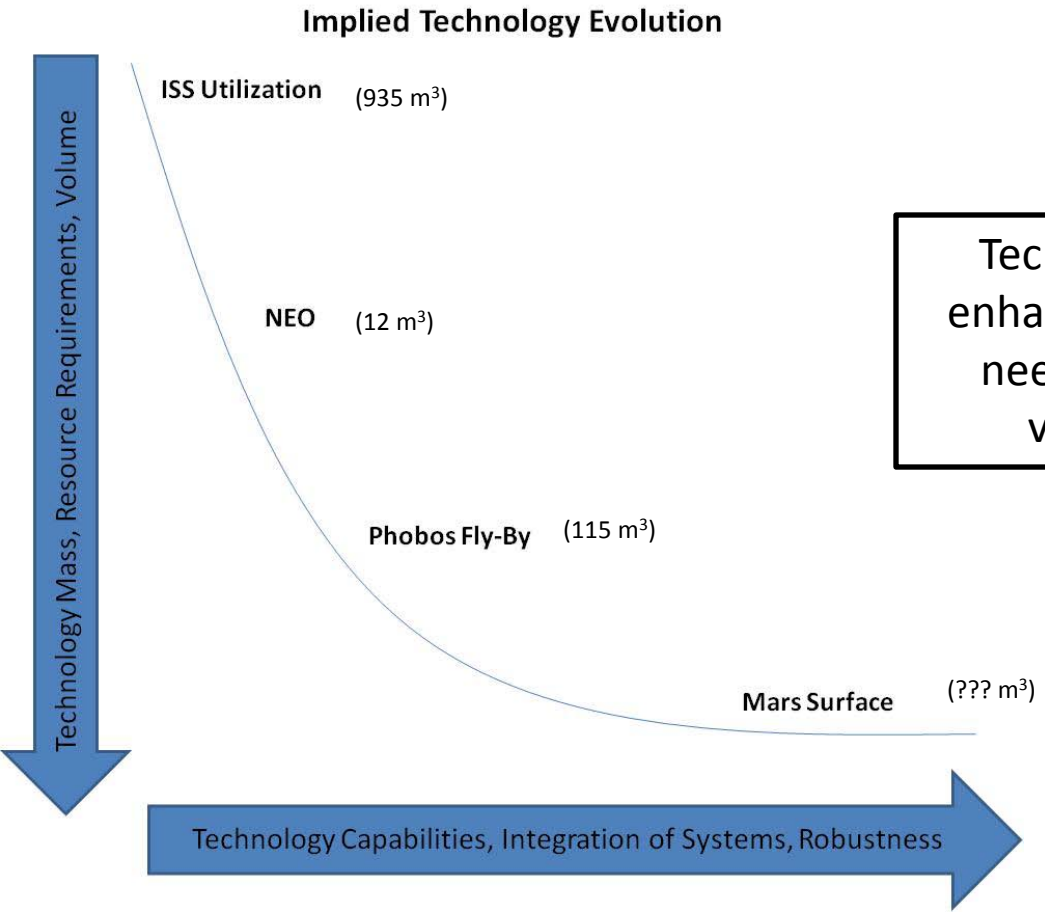
Potential technology needs



- Physiome
  - Physiological monitoring
  - Diagnostics/health screening
  - Microscopy
  - Cellular imaging
- Genome
  - Microarrays
  - Whole transcriptome analysis (sequencing)
  - Real time PCR
  - Services
- Proteome
  - Microarrays
    - Antibodies
    - Protein
    - Ligands
    - Aptamers
  - Mass spectrometry
  - Chromatography
- Spectrophotometry
- Quantitative imaging
- Bioinformatics
- In-flight training

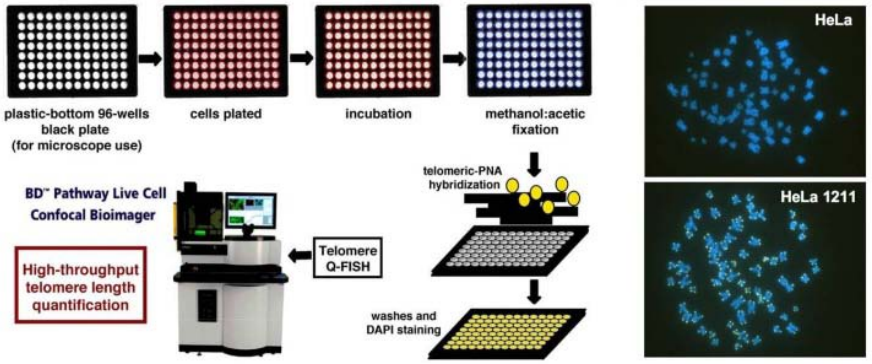
The general principle that guides much of our technology development is to integrate individual devices into small, flight-ready, reportable units. At the same time, we must increase capability while reducing mass, volume and power requirements. Figure 1 shows this concept graphically as related to cost and capability. This approach will lead to the greatest contribution to mission success.



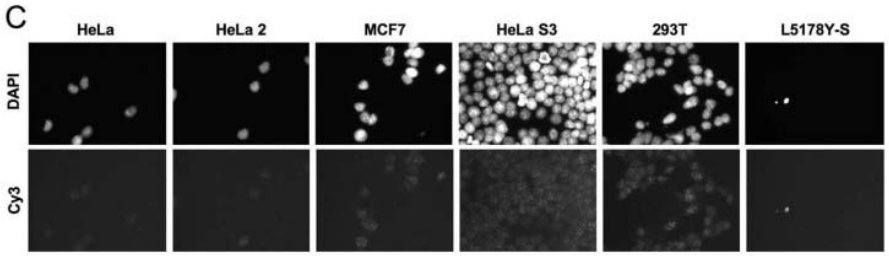
Technology capabilities will be gradually enhanced while the resource requirements needed to fly those technologies (mass, volume, etc) will steadily decrease.

Figure 1.

Exploration class space travel beyond low Earth orbit will present numerous challenges to human physiology. The maintenance of Human health and performance will require research before and during these flights. Early development of enabling technologies will be required to keep the crew safe (countermeasure development).

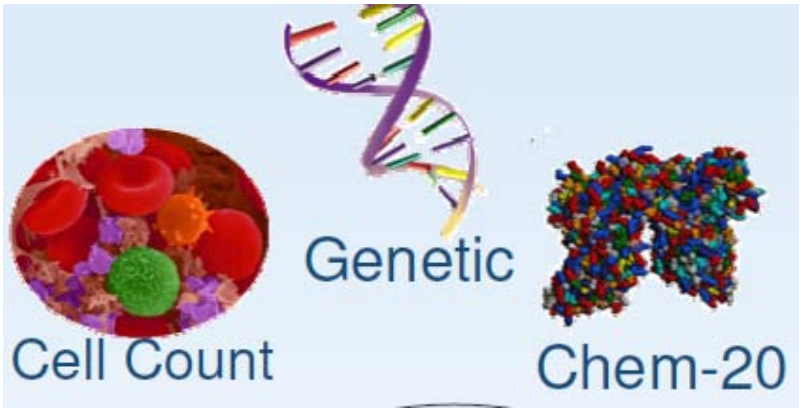


Agilent 5975T field MS



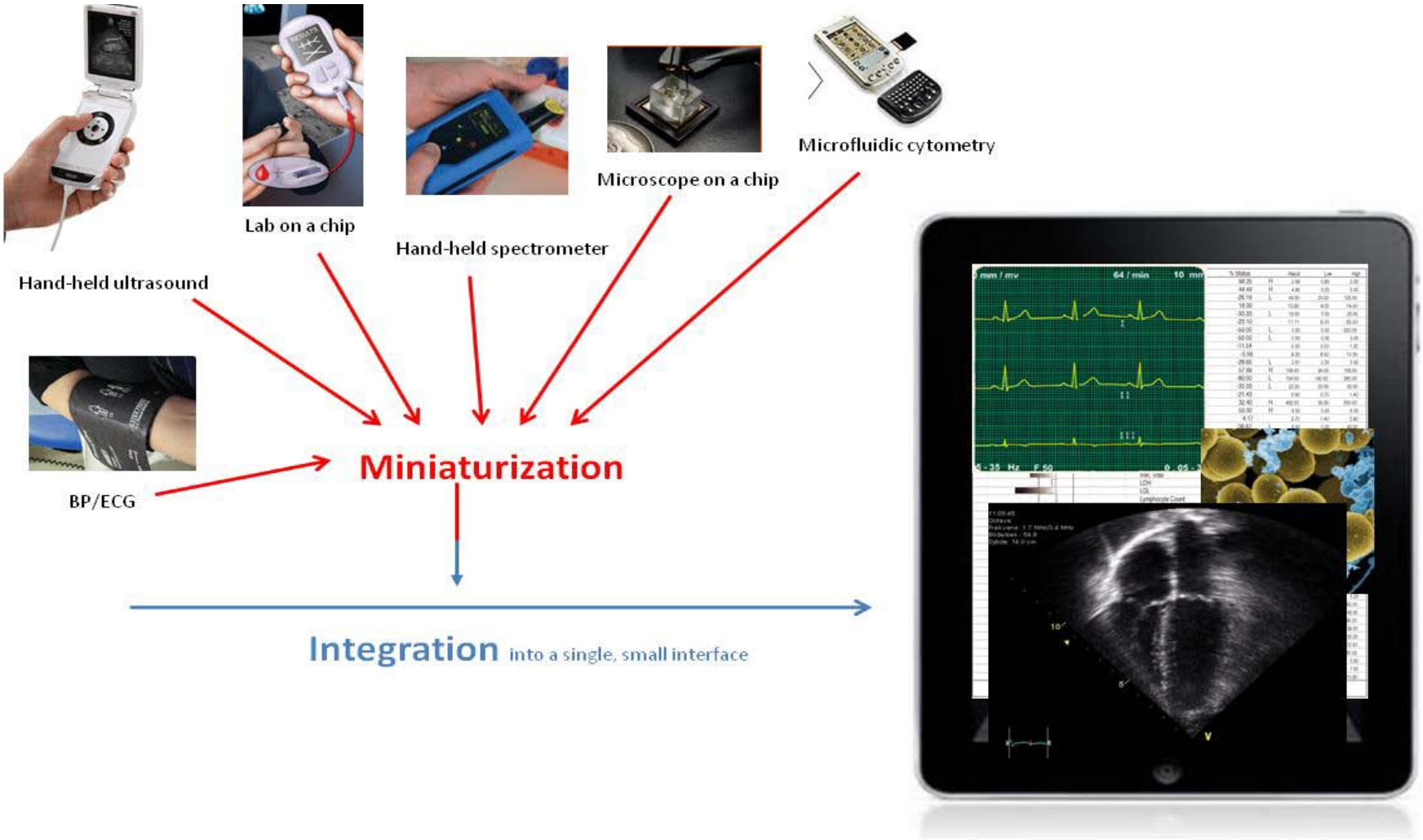
Applications of bioanalytical in-flight tests

In-flight blood, saliva, urine tests



In-flight environmental testing: Test water, food, air and surfaces

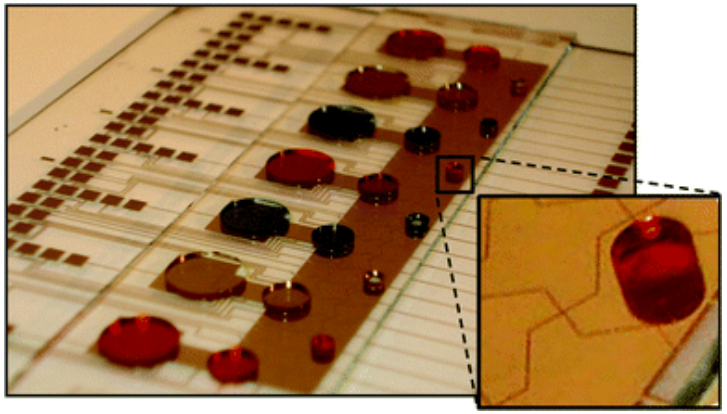
We will also have to conduct research in new, smaller vehicles (field lab, sample analysis). A number of these proposed technologies can be transitioned to medical practice once they have been fully validated (imaging, monitoring, artificial gravity) by the research community.



Cell culture models for research

Conventional cell culture

- Miniaturization
- "Microgravity friendly"

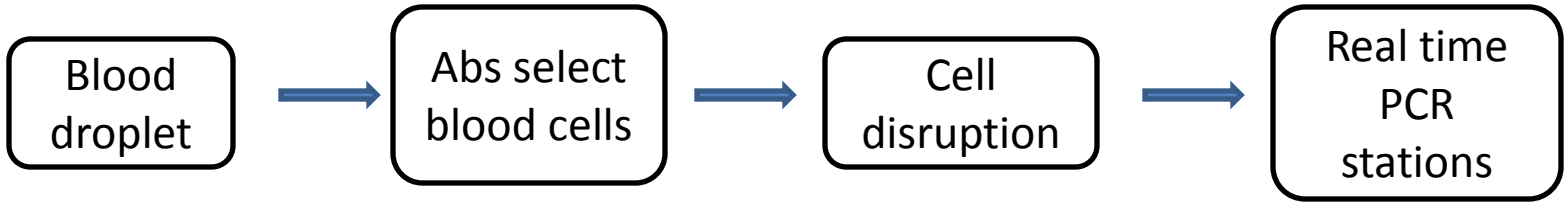


Lab Chip. 2010 Apr 15, A Wheeler device

Lab-on-chip Cell Culture

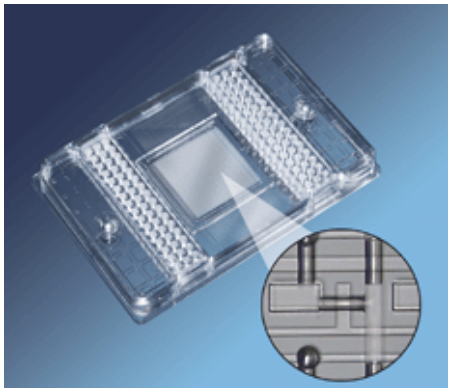
Ideally implementing all steps on a single device: mammalian cell culture-cell seeding, growth, detachment, re-seeding on a fresh surface and sample collection

Lab-on-Chip PCR technologies to explore

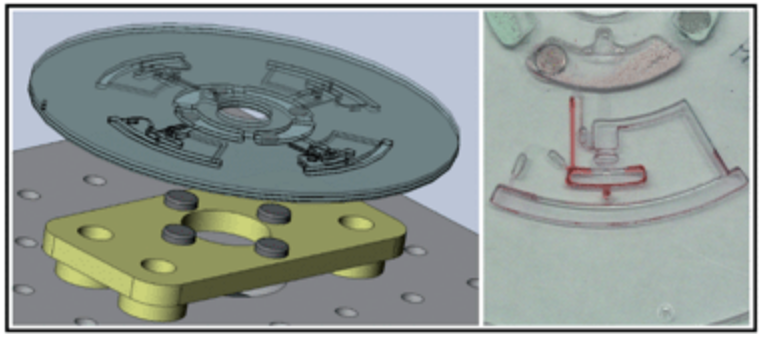


All stations on the same chip, from <25 ul blood, whole process: <15 minutes

Examples



Fluidigm's Digital PCR (dPCR)



Lab Chip, 2010, **10**, 363 – 371, Siegrist et al device

Various emerging LOC-PCR systems

Other cross cutting technologies will provide significant value to other discipline teams (rapid prototyping/manufacturing, 3-D immersive training) and provide excellent platforms for collaborative development.